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## RECORD OF BORINGS IN THE SULPHUR SPRING VALLEY, ARIZONA, AND OF AGRICULTURAL EXPERIMENTS IN THE SAME LOCALITY.

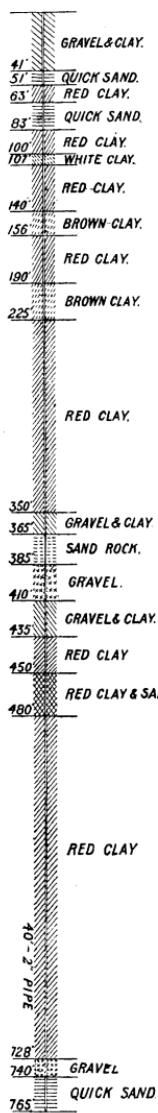
BY JAMES DOUGLAS.

*(Read November 1, 1901.)*

The Copper Queen Consolidated Mining Company has since 1880 worked extensive copper deposits in what are probably carboniferous limestones, lying on the eastern flank of the Mule Pass Mountains, in Cochise county, Arizona, within a few miles of the Mexican boundary and 5700 feet above the sea. The geology of the region east of the Mule Pass Mountains renders it probable that there are Jura-Triassic strata lying unconformably over the carboniferous limestones, and that within the Jura-Triassic there may occur coal. Where coal occurs in Northern Sonora, to the south of the great Sulphur Spring Valley, and in Arizona, to the north of that valley, the beds are so shattered by intrusive rocks as to detract largely from their commercial value. But beneath the broad Sulphur Spring Valley we considered it possible that there might be undisturbed coal beds of sufficient extent to warrant their exploitation. With the object of determining this, the Copper Queen Company drove a diamond drill hole in the trough of the valley. The attempt was abandoned before solid rock was reached. The diamond drill penetrated the alluvium, as shown by the following record of borings, for 765 feet without reaching solid rock. The record is interesting as showing the extent of erosion and the depth to which the valleys are filled by detritus in the arid region.

At the same time, the Copper Queen Company, being anxious to develop every possible industry in connection with their mines, and as a feeder of their railroad, instituted some systematic agricultural experiments on a tract of land lying in the trough of the same Sulphur Spring Valley. The valley extends in a general north-and-south direction for about one hundred and twenty miles, and, with very gradually sloping sides, has an average width of about twenty miles. It is surrounded to the north, east and west by high arid mountain ranges, on which the average annual rainfall is ten inches. While a certain proportion of this moisture escapes by evaporation, the larger portion sinks through the porous soils and collects as a

subterranean reservoir in the basin-shaped valley, which has a very gentle fall to the south, and therefore discharges some of its water



contents, by the subterranean stream of the Agua Prieta, into the headwaters of the Yaqui river. The water in abundance is struck at from nine to thirty feet below the surface almost anywhere in the trough of the valley; and experiments extending over three years showed that ten acres of fruit trees can be irrigated by twenty-foot windmills, provided adequate reservoirs are provided. If, therefore, a valuable product, such as fine fruits, could be raised under the climatic conditions prevailing, the question of power for artificial irrigation may be regarded as solved. The attempt, however, to cultivate semi-tropical fruits failed, principally through the extraordinary variations of temperature.

During the term of the experiment a thermometrical record was kept on the ranch, which is printed below in parallel columns with a record for the same period kept at Bisbee. This mining town is situated in a deep ravine in the Mule Pass Mountains, which flank the Sulphur Spring Valley on the west, 1200 feet above the level of the valley, but where, despite the higher altitude, the diurnal variations in the annual experiments are less than in the valley itself. These great sandy valleys in the Southwest, covered at best with a scanty growth of mesquite, and during the greater part of the year by scorched grass, permit of such rapid radiation through the cloudless heavens, that the burning heat of the day falls, immediately the sun sets, to a temperature which is sensibly chilling, and which therefore has a seriously detrimental influence on delicate vegetation. Were these vast valleys simultaneously cultivated and clothed with verdure, this climatic obstacle to agriculture would be reduced, as is the case in the Salt River Valley, where an area of large enough extent is under cultivation to almost relieve the rancher

from the risk of spring frosts. In the fruit culture experiments made the extreme cold occasionally registered in January did not seem to injure even such delicate trees as the almond, due doubtless to the absolute aridity of the soil and the air. But the trees broke into bloom in February, and the fruit was fully formed when April frosts destroyed it year after year. The terrific midday heat of summer days would also cause a plant apparently healthy in the morning to wither and die before evening, although the root was thoroughly irrigated.

The result of our experiments led us to believe that these broad valleys, which originate in Southern New Mexico and Arizona and stretch into Northern Mexico, though arid at the surface, have at comparatively shallow depths a subterranean water supply sufficient to irrigate their very large areas of very rich land ; that the winds are sufficiently strong and constant to raise the water to the surface, through the agency of windmills, for the irrigation of fruit trees on farms large enough to occupy the energies of single ranchers ; that the climatic conditions are the principal hindrances to the success of that branch of agriculture ; but that if coöperative efforts were made to cultivate very large tracts, these climatic conditions would be so modified as to render the cultivation of these vast tracts possible and profitable.

## MAXIMUM AND MINIMUM TEMPERATURES,

taken in the Sulphur Spring Valley, at 4500 feet above sea level, and at Bisbee, at 5700 feet above sea level, both localities being in the same latitude and twenty miles apart.

## TEMPERATURE IN SULPHUR SPRING VALLEY.

1891	Average.			
	Max.	Min.	Max.	Min.
March	72.9	33.1	91.	16.
April	83.4	36.2	98.	24.
May	88.7	43.2	96.	34.
June	98.7	51.8	109.	40.
July	103.1	63.1	107.	55.
Aug.	94.3	61.	105.	56.
Sept.	94.4	52.6	102.	38.
Oct.	84.5	41.4	91.	30.
Nov.	72.3	29.4	83.	19.
Dec.	57.2	15.4	74.	1.

## 1892

Jan.	61.4	21.6	74.	6.
Feb.	65.8	29.7	80.	19.
March	68.8	30.6	87.	20.
April	78.	33.4	91.	19.
May	88.	39.6	97.	28.
June	96.5	47.1	105.	29.
July	97.3	60.6	102.	50.
Aug.	95.4	56.3	102.	47.
Sept.	91.3	46.5	99.	34.
Oct.	80.7	36.	91.	22.
Nov.	69.	30.7	78.	24.
Dec.	58.1	20.9	75.	6.

## TEMPERATURE AT BISBEE.

1891	Average.			
	2 P.M.	Min.	Max.	Min.
March	63.	39.5	76.	25.
April	72.9	46.1	83.	36.
May	77.4	52.6	84.	41.
June	85.9	60.4	96.	48.
July	91.2	68.3	98.	62.
Aug.	83.	68.4	97.	60.
Sept.	84.2	60.3	91.	50.
Oct.	79.6	49.6	97.	42.
Nov.	70.3	44.7	80.	34.
Dec.	54.6	31.6	70.	15.

## DIURNAL VARIATION.

Average diurnal maximum . . . . .	92.6	Average diurnal maximum . . . . .	85.8
" " minimum . . . . .	28.4	" " minimum . . . . .	39.3
Difference. . . . .	64.2	Difference. . . . .	46.5